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27 May 1964

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MEMORANDUM FOR: [REDACTED] OSA

SUBJECT : "Research on Photo Interpreter Performance"
Project P&DS/NPIC

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1. Enclosed is a copy of the Project Approval Request for the Human Factors [REDACTED] project, which was signed by Mr. Lundahl on 18 May 1964 and forwarded to the DDI for approval.

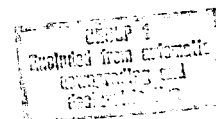
2. In this case, the PAR also suffices for "development objectives" which are usually written on a proposed project: since it is the most comprehensive statement of the project, it is provided for your reference and information.

3. Having designated domestic targets of initial interest, we are now beginning to look through photography obtained from ACIC to evaluate the final suitability of each target for the overall research task. Our meetings and seminars at [REDACTED] (9,12 June) should give the participants an unusual opportunity to delve into all facets of the project and to correlate one another's part and work during these intervening weeks since the pilot study. By then, we should be ready to arrange the actual overflights.

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[REDACTED]
Development Branch, P&DS



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Research and Development
Project Approval Request

I. Identification

The proposed project, designated "Research on Photo Interpreter Performance," would follow up a pilot study on "Photographic Image Recognition as a Function of Ground Resolution" which was conducted by [REDACTED] Human Factors Research, and NPIC, to prove that information from this kind of experimental research is meaningful and useful to the photographic intelligence process. The proposed effort, endorsed by DD/S&T on merit of the successful pilot study, would be funded by NPIC [REDACTED] would make use of NPIC facilities and experimental subjects, and would be of joint interest to DD/S&T and NPIC.

This project is provided for in the NPIC's FY64 financial plan at the [REDACTED] level under two categories of Object Class 700: "Viewers and Other Photo Interpretation Equipment" [REDACTED], and "Special Techniques and Development Studies" [REDACTED]. The remaining funds are available as a result of deferment of other projects for further investigation.

II. Objectives

In extending the findings of the pilot study, the proposed program would investigate three principal and basic areas of concern. Objectives would consequently be:

- A. To determine the relation between P.I. performance and ground resolution of photography.
- B. To assess the effects of stereo image viewing (as opposed to monocular viewing) as well as the effect of mixed-resolution stereo pairs on P.I. performance.
- C. To investigate the effects of color photography on P.I. performance.

Findings will supply objective measurements which will serve to aid in the development and use of collection systems and exploitation equipment.

III. Background

In NPIC's particular intelligence effort, "man" -- the photo interpreter -- is the key element and yet he remains the most unknown factor in the total picture.

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There are proven techniques for attaching numbers to systems capability (currently in terms of "modulation transfer function"); but there is no means, to date, of quantitatively accounting for or predicting or enhancing human performance as it relates to the quality and kinds of materials available in the interpretation task. This vagueness inhibits our development programs.

In general terms, we want first to ask ourselves what threshold of quality is incontestably set by accountable human factors? What degree of image quality is really needed for specific targets (for this will vary); and exactly what details do we want to be able to see in various targets? When do stereo and color, for instance, provide more information to the human visual system?

At long last, a value could be put on the direct benefits of resolution, stereo and color:

- A. Results from the resolution study will aid in assessing the relative intelligence worth of various collection systems which yield different ground resolutions. This objective, in a skeletal version, formed the basis of the pilot study, but would now be specifically correlated with types and priorities of targets suggested by the operational components cooperating in the study. The resolution study will establish a benchmark from which effects of other physical factors can be measured.
- B. From an investigation of stereo, NPIC would finally have in its hands some relative numbers for evaluating (or justifying) stereo as it directly contributes to identifying specific kinds of targets.
- C. The study on color will include investigations of P.I. performance with monocular color images, of stereo images in which (1) both images are in color and (2) one image is in color and the other is in black & white. Variations in ground resolution will be introduced for both the monocular and stereo images. Results will be useful in deciding and detailing the roles that color might, with some degree of assurance, take in collection and exploitation.

In what is a relatively unexplored area, the first facts and findings will be necessarily basic and therefore important, with many side benefits.

Additional studies may be carried on simultaneously -- as they have an effect upon the overall investigation. For example: experiments at Harvard University's Center for Cognitive Studies suggest that image identification of degraded images can be strongly influenced by pre-conceptions, such as the sort of pre-conception a P.I. might unconsciously have gained in his own specialization (of target-type). Called "response perseveration," it can decidedly interfere with recognition. It also encourages a person's first notion about lower-grade information to stick in his mind, obstructing other alternatives. Findings from such research will be applied to the proposed

project and, in this case, might be incorporated as multiple-choice testing techniques. Further exploration and application might prescribe a scheme, for instance, of presenting collateral information to the P.I. and of assigning (or rotating) tasks for the most objective interpretation possible.

Another obvious offshoot is an investigation of basic aptitudes, background and personality traits which are essential to the successfully performing P.I.

Other factors of contiguous or future concern are:

- | | |
|----------------------------------|---------------------------------|
| 1. contrast and brightness range | 7. scene change detection |
| 2. granularity | 8. season/terrain |
| 3. sun altitude and azimuth | 9. searching and viewing time |
| 4. obliquity | 10. viewing equipment/scale |
| 5. infrared photography | 11. collateral information |
| 6. real color v.s. false color | 12. individual P.I. differences |

IV. Technical Specifications

All findings and figures will be submitted in report form and will also be represented in graphs. Graphs, covering all important target-types, will plot ground resolution (from a range of 1-10 feet) against target identification. Curves for the same target-type will contrast stereo with monoscopic viewing and color with black & white.

With the help of operational components a survey of targets of interest (which are available within the U.S.) was designated. Photography should include:

1. Missiles (ICBM)
2. Electronics (antennae)
3. Military (air fields and submarine sites, with nuclear facilities)
4. Storage (military, ammo, BW/CW)
5. Industry
6. Transportation (land, sea, ports and harbors)
7. Power

For the following reasons, actual mission photography is unsuitable for the project and special flights must be flown: (1) techniques for simulating scale and resolution of photography require known and exact processing parameters so that accurate transfer function can be determined. (2) Images must be selected by specific recognition characteristics for purposes of testing. (3) For purposes of correlation, color photography must be identical to black & white photography and consequently must be shot at the exact same time.

However, as a doublecheck and also in the process of specifying sites to be photographed, the researchers will review Air Force reconnaissance (data) test flights. If material is suitable, it will be used. It is probably from this source that materials will be obtained for pretests, the purpose of which is to determine meaningful alternatives for multiple-choice answers.

The OSA/Air Force will be responsible for providing the aircraft, cameras, and original film-processing necessary for collecting the photography. In the event that ground targets are required, the sponsor will make the necessary arrangements.

Since simulation techniques will be used for degrading resolution, the initial photography must be of high quality (a ground resolution of 6"). Photography must also cover a long strip of terrain at least $\frac{1}{2}$ mile wide. It must provide at least 60% overlap between frames. Targets must be covered in both color and black & white. Further specifications have been discussed with the proposed contractors, and there is leeway for selecting the remaining parameters in terms of our logistical convenience.

V. Contractor and Financial Arrangements

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Through joint agreement between DD/S&T and NPIC, [REDACTED] and [REDACTED], were asked to submit the only proposal as sole bidder and joint contractors. They are uniquely qualified in terms of professional competence, personnel thoroughly familiar with our operation, and investigative techniques specially adapted for our purposes. Moreover, the resolution simulation techniques were developed by [REDACTED] and are proprietary in nature. 25X1A

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[REDACTED] will serve as principal investigator representing [REDACTED] will serve as principal investigator representing [REDACTED] Ultimate responsibility for the research will rest [REDACTED].

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VI. Coordination

From its inception the project has been coordinated with PID/NPIC and DD/S&T. The Office of Logistics has taken the preliminary steps necessary for contract negotiation.

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A thorough survey of research and literature on the psycho-physiological aspects of the P.I. function was part of an earlier study performed for NPIC by [REDACTED] in 1960. Recently, [REDACTED] has reviewed current research in this field with NPIC technical personnel, and it was consequently concluded

that other efforts are not applicable to NPIC's standard of materials -- that is, based upon the quality of material now being acquired. It is also felt that (1). techniques used to date in service-sponsored studies of photo interpretation were inadequate in experimental design and did not yield objective criteria; and (2). that these and other studies did not ask questions analogous to NPIC interpretation tasks.

As a result, the contractors will from necessity collaborate closely with NPIC P.I.s and will correlate questions with the kinds of intelligence requirements presently levied on the Center. Looking to the future, projected requirements for image recognition will also be incorporated into the testing, since current intelligence requirements are most often defined to fit NPIC's present capability and not necessarily to exceed it.

As a general reference on the project, [REDACTED] will submit a short summary/evaluation of current and recent research which he judges partially relevant to this proposed undertaking -- either in terms of techniques or findings.

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VII. Security

The contract will be SC-1 and association with the Agency will be classified at the Confidential level.